

ABSTRACT

The non-uniformity of electroplating on wafers is due to the appreciable resistance of the thin seed layer and edge effects. Mathematical analysis of the current distribution during wafer electroplating reveals that the ratio between the resistance of the thin deposited seed layer and the resistance of the electrolyte and the electrochemical reaction determines the uniformity of the electroplated layer. Uniform plating is critical-in-wafer metallization for the subsequent step of chemical mechanical polishing of the wafer. Based on the analysis, methods to improve the uniformity of metal electroplating over the entire wafer include increasing the resistance of the electrolyte, increasing the distance between the wafer and the anode, increasing the thickness of the seed layer, increasing the ionic resistance of a porous separator placed between the wafer and the anode, placement of a rotating distributor in front of the wafer, and establishing contacts at the center of the wafer. The rotating distributor generates multiple jets hitting the surface of the wafer, thus ensuring conformal electroplating. The jets can be either submerged in the electrolyte or above the level of the electrolyte. The shape and uniformity of the electroplated layer can be also determined by the shape and relative size of the counter-electrode (anode), by masking the edge of the wafer and by periodically reversing the plating current. The problem of uniformity is more severe as the diameter of the wafer becomes larger.